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Vertical timetabling in Year 4 mathematics: Teachers' perceptions and reflections on practice

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Abstract

Curriculum differentiation is an important strategy that acknowledges the need to provide appropriately challenging learning experiences for all children. Both high ability students and those with learning difficulties require pedagogical practices that specifically meet their needs. Vertical timetabling is one approach to restructuring curricula commonly found in secondary schools, which allows students to engage in challenging learning experiences appropriate for their ability levels. The approach is predicated on student choice and appropriate content. This chapter reports on a teacher-led action research project at "Learning Place" which involved developing, trialling and implementing vertically timetabled mathematics lessons in Year 4 over a six-month period. A vertically timetabled approach was seen as an opportunity by the teachers concerned to provide appropriate learning experiences to three distinct cohorts of learners—exceptional students, competent students, and those who were struggling with the core work. Participants' reflections on the project, their perceptions of children's academic achievements and their honest self-appraisals were sourced in interviews and provide data. These data indicate that the successful implementation of vertical timetabling was facilitated by participants' desires to lead the intervention, to work collaboratively in planning, teaching and resource sharing, and to critically reflect on their own practice as a teaching team.

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Introduction

The responsibility of schools and educational systems is to provide access to all children in society to ensure that they are able to achieve according to their abilities. In a challenging, supportive and nurturing environment, schools provide a foundation for children's intellectual, physical, social, moral, spiritual and aesthetic development. These sentiments are, for example, expressed in a national commitment that: "Schooling should develop fully the talents and capacities of all students" (Department of Education Training and Youth Affairs [DETYA], 1999). At a national level there is commitment to a vision that Australia's future depends upon each citizen having the necessary knowledge, understanding, skills and values for a productive and rewarding life in an educated, just and open society.

One major social concern is to develop a numerate populace. People need to be able to cope effectively with the practical mathematical demands of everyday life (see Australian Association of Mathematics Teachers, 1997; Australian Council for Educational Research, 1990; Department of Education Training and Youth Affairs [DETYA], 1999; Her Majesty's Inspectorate, 1998; National Council of Teachers of Mathematics, 2000; Steen, 1997). However, society is also dependent on contributions by its most gifted and creative individuals. A sustainable future will require substantial intellectual capital and developments in the sciences—especially the enabling sciences of mathematics, physics and chemistry. However, there is evidence that participation in the enabling sciences is decreasing (see O'Connor, White, Greenwood & Mousley, 2002).

Meeting these diverse demands requires instructional practices and curricula that are appropriate for students with wide ranging ability. This chapter addresses the strategies adopted by a group of teachers exploring the differentiation of instructional practices to engage students of all abilities in the learning of mathematics. The goal of this research was to document and analyse the implementation of a curriculum innovation designed to enhance participation by all students in the learning of mathematics. The research outlined in this chapter is set against the backdrop of a recurring debate among teachers about strategies adopted to cater for students of different ability. Central to this debate is consideration of homogenous versus heterogeneous student groupings, and whether or not 'ability grouping' is an educationally sound practice. This debate is also rooted in the established chronological-age based organisation of schools. We begin this chapter with a brief overview of the relevant literature on catering for the diverse needs of students, especially in mathematics.

Literature background

The provision of enrichment for students with wide-ranging intellectual abilities is an affirmative action initiative that attempts to ensure equality of opportunity by meeting the needs of all students. However, enrichment practices need to be carefully and deliberately implemented with planning, monitoring and evaluation. In this study we focussed particularly on developing strategies to extend the gifted child whilst providing the necessary support for those students who struggle with learning. Strategies frequently used to achieve these goals involve either restructuring school curriculum organisation or changing practices in the classroom. The former is often seen as streaming or ability grouping while the latter involves a form of differentiation of curriculum delivery within the classroom.

Streaming, or ability grouping, involves the homogenous grouping of students based on certain criteria, which may (or may not) include cognitive ability in a particular curriculum area (Ireson, Hallam, Hack, Clark, & Plewis, 2002). In one study of primary schools in the United Kingdom (Hallam, Ireson, Lister, Chaudhury, & Davies, 2003), it was found that less than two per cent of schools adopted any form of streaming. The main argument proposed by

supporters of streaming is that, by differentiating student or class groupings in this way, it gives teachers an opportunity to differentiate the curriculum and to provide for the diversity of interests, skills, abilities and talents of a wider range of students. A longitudinal study by Kerckhoff (1986) concluded that there were net positive effects of ability grouping, confirming that pupils in high ability groups increased their average performance. Notwithstanding that, Ireson et al. (2002) raised concerns about students in low ability groups who might experience low self-esteem, low self-concept and poor attitudes to school and their schoolwork. Further, students who experienced acceleration in mathematics but who had negative attitudes to mathematics and were maths-anxious fared worse than students with positive attitudes and low mathematics anxiety (Ma, 2003). In extensive meta-analytic studies, Kulik and Kulik (2000) and Rogers (2002) provide evidence that higher aptitude students do benefit from ability grouping. Effects are small when this is done as part of a broader programme for students of all abilities and the curriculum is common to groups. However, benefits are enhanced when modified instructional practices are adopted to suit each group's ability.

The process of curriculum differentiation provides tools to vary the curriculum so that students who have already mastered given material can progress, or whose potential giftedness is not cultivated by the standard curriculum can pursue an area in greater depth while still providing necessary challenge and support for those students who have not yet mastered the material. VanTassel-Baska (2000) has analysed the variety of curriculum development models and identified two broad approaches. The first she describes as a "design down" model, which is based on acceleration principles where the curriculum processes are "speeded up and shortened" for the gifted. The second approach draws from notions of enrichment and addresses a broader conception of giftedness, taking into account creativity and motivation. Curriculum differentiation is a form of enrichment approach through which teachers challenge individuals within a classroom through a range of strategies that include: Tiered Assignments, Flexible Skills Groupings, Learning Centres, Compacting, Mentorships, and Independent Projects or contracts (e.g. Feldhusen, Hansen, & Kennedy, 1989; Maker, 1983; Rogers, 2002; Tomlinson, 2000). More recently, Tomlinson et al. (2001) have described the notion of a "parallel" curriculum to challenge a wide variety of learners, including students whose abilities often go undiscovered in school because they do not fit a traditional image of an achieving student.

Implications for intervention

In every classroom there is a range of abilities. At the extremes we have those exceptional students who struggle with content while simultaneously we have students who are capable of performing at exceptionally advanced levels in relation to their same-age peers. In relation to mathematics some students learn at a slower pace and have difficulty with retention, while others have reasoning deficits that inhibit learning (Montague, 1998). In comparison, mathematically gifted students are distinguished by their mathematical reasoning, their capacity for learning, and their mathematical orientation (House, 1987). Supporting gifted students requires differentiated approaches that modify the content and pace of the curriculum (Maker, 1983) which, in the case of mathematics, can imply specific task-related strategies (Diezmann, Thornton, & Watters, 2003; Diezmann & Watters, 1992, 1994; Diezmann, Watters, & English, 2000; Sheffield, 1999). These approaches undertaken in the regular classroom enhance gifted students' reasoning, accommodate their capacity for learning, and foster their interests in accordance with best practice in gifted education (National Association for Gifted Children, 2001). Specific strategies must also be implemented to support those students struggling with mathematics. Many students are at risk because they have never

learned accessible, effective cognitive strategies necessary to understand mathematics (Bley & Thornton 2001; Montague 1998) for approaching problem solving.

Given the significant research on ability grouping and other forms of support for differentiated curriculum, the success of any intervention will depend on how the learning experience is modified to suit the specific needs of students. In this study, the approach adopted was to develop a form of ability grouping termed locally as "vertical timetabling". Vertical timetabling differs from streaming and regular notions of ability grouping because students are able to move between classes and access learning at their own level of ability, depending on the content studied or the concepts being taught (Fardell, 2003; Reid, 1999). Thus a '*vertical*' classroom is made up of students who have opportunities to study at a particular ability level: introductory, standard, advanced, or extended.

The context and programme

This study took place at an outer-suburban school with approximately 650 students and 26 classroom teachers. Approximately one third of the current teaching staff began at the school when it opened; one third had been transferred from nearby schools in low socio-economic areas; another third are teachers on short to long term contracts. Staff have developed coping strategies to deal with a high frequency of student disruption and they are generally accustomed to students with learning disabilities, special needs and who come from unstable family situations. Classes in Years 1 to 3 are grouped heterogeneously in a multi-age setting, while Years 4 to 7 are grouped homogeneously by scholastic year. In this chapter, the school will be referred to as '*Learning Place*'. For the teachers involved in this study, vertical timetabling represented an innovation in teaching mathematics in the middle years of primary school. There was a critical need to improve students' performance on state-wide standardised tests and to transform student engagement with mathematics. Until the introduction of vertically timetabled mathematics lessons, students exhibited a poor attitude to mathematics generally and a high level of mathematics anxiety. Some researchers have linked students' attitudes and anxieties in mathematics to their teachers' attitudes and anxieties that, again, originate during primary schooling (see Uusimaki & Nason, 2003). Teachers at Learning Place made the commitment to improve their planning, teaching and resource sharing so that their lessons could be positive and engaging, and promote perseverance and a generally positive attitude towards learning. Thus the aim of this study was to identify and examine the participants' perceptions and reflections regarding their teaching practice; both as individuals and as a team of teacher-researchers engaged in the development of a curriculum innovation.

Methodology

This study has adopted an action research approach. Action research is formally defined as "the application of fact finding to practical problem solving in a social situation with a view to improve the quality of action within" (Burns, 1994, p. 293). According to Delahaye (2000), action research is a "model used in managing the process in change interventions" (p. 333). It is a methodology that focuses on improving teachers' practice and it consists of cycles of action involving phases; problem identification, plan of action, data collection, data analysis, and plans for future action (Carr & Kemmis, 1986; Donner, 2001). The action research project at Learning Place began with an investigation of a suite of strategies—including streaming, accelerated progression and vertical timetabling—that could be implemented to improve student achievement in mathematics, with a view that any organisational change should indicate it was having a positive effect on students and thereby able to enhance the

school's results on state-wide tests. It also came as an appropriate solution to a growing need within the school to provide a high standard of extension work to students considered by their parents, teachers and peers as cognitively gifted in mathematics. Since the beginning of the year, there was significant pressure from parents for teachers to give attention to these students who were complaining of boredom with mathematics.

One of us (MH) became involved as a teacher-researcher in the process of planning, acting and reflecting (see Loughran, Mitchell, & Mitchell, 2002; MacLean & Mohr, 1999) on a vertical timetabling intervention across Year 4 when assigned to teach 4A at the school in 2002. Vertical timetabling was chosen as the most appropriate strategy for the school's cohort of learners because it allowed the Year 4 teachers to target their teaching to the three distinct student groupings that they had identified; competent students who were achieving at a Year 4 level, exceptional students working beyond the Year 4 requirement, and those students who were struggling with the core work. The project team consisted of three Year 4 teachers ('Mitch', 'Tamika', and Matthew) the Principal ('Jill') and the Learning Support Teacher ('Christine'). The team decided on a *plan of action* (see Donner, 2001) as to how the vertical timetable would be structured to best meet the learning needs of students, and to deliver on promises made to parents that extension would be provided wherever possible. A summary of this team's major decisions are summarised in Table 1.

Table 1:
Summary of the vertical timetable plan of action

1. A six-month trial of a vertical timetable for mathematics would take place across the entire Year 4 cohort for the remainder of 2002.
2. Students would be grouped into three classes based on semester one results for mathematics (data will be gathered from testing results and student portfolios).
3. The three groups would cater to *beginning*, *intermediate* and *advanced* ability levels, although the classes would be called 'establishing', 'consolidating' and 'extending' so as not to inappropriately label student groups.
4. Advanced classes would provide extension for students working beyond the Year 4 mathematics syllabus whereas intermediate classes would work at the syllabus standard.
5. Students experiencing difficulty in mathematics would be catered for in a beginners group of a smaller cohort (of about twenty students), with greater Teacher-Aide and Learning Support Teacher support, and with enhanced access to concrete materials and other resources.
6. Students that show improvement in mathematics achievement could "graduate" to a higher mathematics group, and, conversely, students that struggle with the work would have the opportunity to request a transfer, or to be transferred, to a lower group.
7. Students would move from their home classroom to their mathematics classroom half an hour after the commencement of school on Wednesdays, Thursdays and Fridays, to a weekly total of four hours.
8. Vertically-timetabled maths classes could be supplemented by mathematics lessons in the home [or pastoral care group] classroom if required.

The abovementioned decisions were taken after the participants had considerable time to do their own research into vertical timetabling, and much of this research data was communicated to the other participants during semi-regular meetings held to discuss the new initiative which would begin at the commencement of Semester II. This timeframe would ensure that new classroom procedures and social conventions could be taught to students immediately following the school holidays. The rationale was that students would be better prepared for the necessary changes to the school-day which included moving to other classes, interacting with unfamiliar teachers, and building new relationships with other pupils outside of their established class and friendship groups. Careful attention had been paid to aspects of

the *affective domain* (Krathwohl, Bloom, & Masia, 1964), or the hidden curriculum, that comprises social conventions and classroom cultures, because the school had a relatively high proportion of students with learning difficulties (about 25 per cent according to the Principal), including students with Autism and Speech-Language Impairments, who required extra support if they were to adjust to the change successfully.

Data sources

Teachers' reflections provide anecdotal evidence and *individual perceptions* (see Powers, 1981, 1989) about their common experience of vertical timetabling. These experiential data are essential to uncovering those key factors which a) facilitated change at the school, b) assisted teachers to adopt a significantly different approach to teaching, and c) allowed for a more collaborative and collegial discourse about pedagogy.

Permission to interview the Principal, the Learning Support Teacher, and two of the Year 4 teachers was gained from all of the participants interviewed, and also from the Principal as the school's officer-in-charge. Participants agreed that their comments could be used and attributed to them in this chapter. Although it was our intention to interview students about their experiences of vertical timetabling as well, there was not sufficient time to gather ethical clearance or to obtain consent from the students and their parents.

A semi-structured interview schedule (see Table 2) was developed so that qualitative evidence could be corroborated among the four participants involved in the action research project. The participants were interviewed approximately six months after the vertical timetable intervention was institutionalised across Years 4 to 7 at the school, and interviews were conducted on-site and at a time convenient to the participants. During the course of the interviews it became necessary to ask follow-up questions so that participants could elucidate and expand on their initial responses. These interviews were recorded for later transcription and content analyses. On average, interviews were of 30 minutes duration, which was ample time to gauge participants' responses. Participants were sent a copy of their own interview transcript via e-mail and asked to check for any discrepancies between the transcript and their recollection of what was said. Participants were satisfied that the transcripts were a faithful record of the interviews that took place.

Table 2:
Questions administered to the participants

1. What is your understanding of *vertical timetabling*?
2. What was the *plan of action* when the decision to undertake a trial of vertical timetabling took place?
3. In your opinion, what were the problems that led to the development of the vertical timetable for maths?
4. What were your main concerns about the plan?
5. What were your main concerns about vertical timetabling?
6. What were your main concerns about teaching mathematics in this new way?
7. What strategies did you use to ensure that your students were well-prepared for the changes to come?
8. In your opinion, how did students respond to the change?
9. What changes did you notice in your students at the beginning of the vertical timetable trial?
10. What changes did you notice in your students at the end of the vertical timetable trial?

Supplementary questions to the Year 4 teachers:

11. What changes did you notice in your students at the beginning of the vertical timetable trial?
12. What changes did you notice in your students at the end of the vertical timetable trial?
13. What changes to your teaching practice have you made this year that emerged from your experiences of the Year 4 trial last year?
14. In regard to planning, teaching and resource sharing, what was done last year that benefited your teaching in maths?

Supplementary questions to the Principal and Learning Support Teacher:

11. What changes did you notice in the students at the beginning of the vertical timetable trial?
12. What changes did you notice in the students at the end of the vertical timetable trial?
13. How did you see your role in the whole process, from start to finish?
14. Please comment on any aspects of planning, teaching and resource sharing that occurred amongst teachers last year that you think benefited their teaching in maths.

Data analysis techniques were based on a constant comparative approach to qualitative research involving the review of transcripts, the identification of significant themes and the corroboration of such themes with further evidence from other participants' interview responses (see Creswell, 2002; Glesne, 1999). The process began with transcribing interviews, then reading and re-reading transcripts for key phrases, followed by the reduction of key phrases into broader key themes. Themes were considered significant if they could be corroborated from two or more participants' interview responses.

Results

The findings of the study are now summarised under the headings of the key themes which emerged from this process of constant comparison. They are: a) participants' beliefs about vertical timetabling; b) human and physical resource sharing; c) participants' perceptions of students' responses to vertical timetabling; d) participants' perceptions of parents' responses to vertical timetabling, and; e) staff collaboration during the project.

Participants' beliefs about vertical timetabling

Administrators believed that in a vertical timetable structure children "weren't bound by grades and year levels and ages, and could work where they needed to learn" (Jill). Participants acknowledged that vertical timetabling was an organisational strategy that could be implemented to group students according to ability, but also using other criteria as needed. The Learning Support Teacher, Christine, put it this way:

> *"Vertical timetabling, for me, would be more* [about] *matching children to their ability groupings in a single year level."*

Mitch, one of two Year 4 teachers interviewed, describes it thus:

> *"Vertical timetabling to me is just another strategy that teachers can use. Unfortunately, I don't think we make enough use of those sorts of strategies and it's a really good strategy because it allows you to* [target] *the kids' learning at where they're actually at, rather than teach 'middle-of-the-road' which a lot of teachers won't admit they're doing but they probably are doing it."*

All of the participants believed that vertical timetabling was an appropriate way of reorganising the mathematics curriculum in such a way as to appropriately differentiate teaching and learning for a diverse student cohort.

The key learning area of mathematics was chosen for a trial of vertical timetabling because of its ordered and sequential nature. Tamika outlines the problems she faced in teaching mathematics to a broad spectrum of ability levels in her original class before the implementation of vertical timetabling for the subject:

> *"With my class, I had really bright children—one who could do Year 4-5-6 maths—and then I had children who weren't even able to cope with Year 2 maths. You couldn't even teach to a medium in the classroom because it was such a diverse group of kids. Some kids were just so far ahead and others were so far behind. You never really got anything satisfactory from those ones who weren't achieving anywhere. […] The kids that were struggling had the same reaction—they were being silly, mucking around in the classroom…they would just sit there and stare at me. They couldn't cope with any of the maths situations."*

The flexibility of moving students between the various ability groupings, which differentiates a vertical timetable from traditional forms of streaming, was noted especially so by the teachers concerned. When Mitch was asked about when a student would be offered the chance to move to a higher ability group, he responded by referring to the demonstration of higher-order thinking skills, such as Bloom's (1956) *knowing*, *comprehending* and *applying* skills:

> *"The criteria were demonstration of knowledge and understanding. So not only could they know, for instance, their multiplication number facts, but they had to be able to demonstrate where and how they could use those number facts in a lot of different situations."*

And a student would be moved to a lower ability group if:

> *"…we were moving on to a new concept they were particularly weaker in… we might be doing measurement and the child might be weaker in measurement than they are in number, then they might move back a group to strengthen their understanding of measurement before maybe re-joining their group."*

The teachers undertook a systematic process of grouping children; firstly by using cognitive ability as the primary criterion for group placement, and then by an evaluation of a student's ability (or social readiness) to access learning in the classroom without undue disruption (see Krathwohl et al., 1964). Mitch, who taught the *consolidating* group, summarised the process best when he said:

> *"We went back and we looked at previous tests, we gave them some cloze activities,* [and] *in terms of testing, tested their knowledge of maths over a wide range of different areas, and also looked at their Year 3 tests to establish just where we thought they were. While some kids had particular strengths in one area they had huge weaknesses in others, so we had to balance that out. We also made sure that we could move these children between the groups, so it was critical that the groups didn't get too far distant from one another so that the transition from one group to another was still able to be maintained and able to be offered to the children at any time during the year. […] With the extension group, it was merely explained to the children that this is where we would really be testing your understanding of concepts, and also your knowledge and how you apply that information. The establishing group…was where we actually—fundamentally and physically—moved objects around, concrete materials, to demonstrate and show our understanding. The consolidating group in the middle was the group where we did a combination of both things—where we had concrete materials for them to demonstrate that lateral thinking or more abstract thinking and move more into symbolism, the use of symbols…"*

One question raised at the outset of the project was whether or not students with acute behaviour problems ought to be placed automatically in the *establishing* mathematics group until they could prove themselves by working diligently and, only then, advancing to the next mathematics group of higher ability. Learning Place's school-wide discipline plan is based on Ford's (1997) Responsible Thinking Process™ and provided some clear guidelines about what teachers should do when students disrupt the learning taking place in the classroom; specifically, that the student should be removed from the social context in which the disruption took place. Tamika described what occurred when the teachers were faced with the dilemma of grouping high ability students who had poor behaviour records:

> *"I had a couple of them stay back with me* [in the establishing group] *because their behaviour wasn't going to be sufficient* [for them to stay in the higher ability class] *but we did move some of them up but they worked out to be better off down in my 'room because we looked at the fact that they were disrupting the learning. Because I had extra Aides in my 'room, we had about three extra adults every lesson which made a difference as well."*

The issue of human resource allocation—specifically, about the distribution of Teacher Aide time and access to the Learning Support Teacher's expertise—and the just distribution of concrete mathematical materials would emerge as another key theme from participants' responses.

Human and physical resource sharing

The Year 4 teachers structured their weekly timetable to ensure that human and physical resource support (in the form of Teacher Aides, Learning Support Teacher support and the borrowing of mathematics equipment) could be adjusted to accommodate a tighter weekly schedule alongside specialist teachers' lessons for music, physical education and Japanese. The teachers adopted a deliberate strategy insofar as their vertical timetable should discriminate in favour of students with lower ability and achievement in mathematics when it came to resource allocation. The 'establishing' mathematics group consisted of fewer students (about twenty on average) with more adult helpers (such as Teacher Aides, the Learning Support Teacher and parent helpers) and greater access to concrete materials for the

modelling of mathematical concepts (such as MAB blocks, maths charts, measuring equipment, etc). Mitch's rationale for sharing resources in this way was as follows:

> *"Obviously, there was limited resources across the three levels of Year 4 that we had, but there were a couple of those levels that needed more resources than those kids that could think more laterally and more abstractly. Within the three groups, the beginning group…needed the majority of resources so we had to accommodate them. […] This meant realising and recognising the fact that some children in class might need some concrete materials on their desk to be able to do some of their maths for a while until they caught on, when the concepts were cemented in their heads. […] We try and structure it so we have the learning with the concrete materials, learning in the more symbolic stuff and then we have the learning in the real abstract and we've got to be able to make sure those kids can do those transitions."*

Tamika, who taught the 'establishing' group, had easy access to concrete materials in her classroom. She said:

> *"My kids really needed those basic, hands-on concrete materials that the other two classes really didn't need. All of a sudden* [I] *had more concrete materials than* [I've] *ever had, so that we had more things for each child to use rather than trying to split scarce resources between larger groups of children."*

Christine saw that resource allocation was an integral component to teachers' planning:

> *"I think the planning component…like really planning 'what are the resources you need?', 'what do you need to be thinking about?' and 'what are the steps that those children who have those holes that we are trying to fill, what are they missing and how do we do that?'. I think that was the biggest thing…and sharing the planning across three people."*

Christine's role as Learning Support Teacher allowed her to observe the three mathematics groups at various times during the semester, as well as having time to talk with the teachers about what they were doing in each class.

Participants' perceptions of students' responses to vertical timetabling

A move towards vertical timetabling was seen by the teachers and administrators involved in the action research project as a way of providing appropriate teaching to three very distinct student cohorts. Their aim wasn't change for change's sake, but rather to improve student learning outcomes. Jill says this came about very quickly:

> *"What amazed me there was how quickly it happened. I guess there were two surprises when we met a few weeks later* [to discuss the intervention]. *One of those surprises was how quickly the lower group had settled in and how successful that was and how it was success-oriented for the students because they were engaged at their level and they were passionate about what they were doing. The behaviour results just went down accordingly and so suddenly there was a calmness that had come over that group of kids which had never been there in their whole life at the school. The other thing that came quickly was that the middle group also had settled down and the teacher was finding they were getting through a lot more work, in their words, successfully. Then the top group…was the one that amazed us because it divided itself naturally in two; those able children who worked hard and applied themselves and tried to always do what the teacher needed them to do to complete their tasks and got most of it right, and then some extremely bright children who, in fact, we still hadn't prepared material at their level and really we didn't have them in the right place yet."*

Tamika, the 'establishing' group teacher, was pleased to see that her smaller student cohort were engaged in learning, and for some of her students it was the first time during their schooling that they felt they were achieving in mathematics. Her focus was on reducing students' mathematics anxiety and promoting a positive attitude during her lessons:

> *"We did two days of serious maths and activities, and the third day we did games and that sort of thing so they could see that maths is fun—pretty much getting them to see that maths is fun, that it's not a boring subject, it's not horrible, it's not hard but* [that] *they struggled with it."*

Mitch commented on his students' response to the new social situation in which they were placed:

> *"A lot of them were unsure and I think it was mainly because of the new dynamics within the class groups that we'd made. They didn't have their friends there all the time, they had to make new relationships, and once again that pecking-order, they looked around for who was the smart one, who was the one who could answer the questions, who could we rely on, who don't we want to rely on."*

Mitch noticed that students in his 'consolidating' group were becoming more confident in mathematics, which defied what previous studies into mathematical streaming had found:

> *"Self-confidence had sky-rocketed, particularly in the two lower groups."*

There were other positive developments in students' behaviours that teachers noticed, including eagerness to work in mathematics, excitement about 'graduating' to a higher ability group, and a willingness to work with other teachers and to move between their home classroom and their mathematics classroom. Christine recalls:

> *"They were actually feeling more secure, they were able to ask questions, they were able to feel good about themselves because they didn't see other people doing that more difficult task they knew they couldn't do. They were doing work that they could actually do and they had time to talk to the teacher and they had their needs met by having time for the teacher to actually get to them."*

These behaviours were also noted by students' parents.

Participants' perceptions of parents' responses to vertical timetabling

It was important to the project team that students' parents should support vertical timetabling because of its intended merits. The Year 4 teachers used parent-teacher interviews for oral reporting to make parents aware of the change to how mathematics would be taught in Semester II. Tamika recounted an experience she had with a student's mother:

> *"I had one little girl in my maths class who has detested maths since Year 1 and cannot stand it. Her mum says she hangs for Wednesday to come now because she knows she's got maths and she knows she's achieving. She's gone from very low achievement to pumping along in all her learning now. Her mum said, 'she hates maths, but now look at her. She can't wait for maths to come around because she just loves getting into it'."*

Tamika was able to gauge parent's attitudes to the vertical timetable during oral reporting:

> *"When I spoke to them about where their children were at, where the maths group was working at, and what the Year 4 expectation was and that their child is lower, they are happy to accept their child is lower than the average child if they can see the movement."*

Christine substantiated this information when she said:

> *"I think the parents were a big bonus for all of that because the children were going home and saying how great it was. The parents were coming back and saying 'this is really wonderful', 'I can see my child doing this', 'I can see them improving'. Well, that's got to be a good message for the teacher and the children at the same time."*

Jill surmised that the parents' generally positive attitudes to vertical timetabling came as a result of the work the action research team did before grouping students to ensure they were making good judgements about such placements:

> *"I did have a concern that the parents might have some difficulty if we had to tell them their children were in the lower group. I was also concerned that there might be parents whose children were in the middle group who were going to say it was only because the school hadn't done the right job that their children weren't in the upper group because they should be. None of that happened. The teachers and parents communicated extremely well and because all the groups took on a positive result very quickly, we've had absolutely no problems with parents that I thought may have arisen."*

Staff collaboration during the project

During the early and tentative weeks of the trial, leadership was provided by the Principal and Learning Support Teacher until the trial's teachers felt comfortable with taking responsibility for the successful implementation of vertical timetabling as a teaching team. Jill commented that she saw her role:

> *"Very much as a facilitator. It's one of those things, I believe, if you do the planning and the discussion like we'd done in trying to get to know the cohort and also fully understanding the philosophical reasons and the practical reasons we were trying to do it. Once I had those discussions and the teachers had taken their decisions that they were going for it, and they could see how they were going to work together.*"

From the project administrators' perspectives, their leadership consisted of providing human resource support (in terms of timetabling for extra Teacher Aide time, allowing for flexibility with the specialist teachers' timetables), physical resource support (in terms of locating concrete materials for mathematics lessons) and curriculum leadership (with the Learning Support Teacher as a guest teacher in both the 'establishing' and 'extending' maths classes on an alternating basis). For the remainder of the semester, the Year 4 teachers were entirely responsible for implementing this particular curriculum innovation. Mitch and Tamika were both asked whether or not they perceived that support was forthcoming from the school's administration as a way of confirming Jill's and Christine's roles in the project. Mitch said:

> *"Yeah, a lot of support from admin. […] They provided the stimuli for us to go on with it. The initial concept I think came from them too, but certainly there was that desire by teachers on staff to try and enhance that learning at those developmental levels for kids."*

Tamika agreed that she felt supported by the Learning Support Teacher when:

> *"I worked side-by-side with her and looked where the kids were at, what they could do, and where exactly to start from because I had no idea where I really should start from. I took them right back to basic addition, basic number concepts."*

The Year 4 teachers' collaboration during the initial phases of the project served to lessen concerns that a transition to vertical timetabling would mean a significant adjustment to teachers' personal pedagogy (the strategies adopted for teaching purposes) and classroom culture (the climate of the teacher's classroom and the values they uphold). Mitch, in his first year of tenure at the school, said:

> *"I didn't have any real concerns because I hadn't established a real good teaching repertoire over a long period of time, so I wasn't settled into a particular comfort zone. I think that's one of the biggest concerns for a lot of people is that if you've done something this way for a number of years you're a bit reluctant to move out of that comfort zone. I hadn't established that comfort zone so there were no real concerns."*

The project demonstrated that collegial collaboration on planning, assessment and resource preparation reduced a teacher's workload overall because there was significant sharing of lesson plans and unit materials. For instance, games, worksheets and charts devised by individual teachers were shared between the teaching team. Mitch noted that Friday afternoon meetings were used as *critical reflection time* for the Year 4 teaching team to review the week's progress, to meet with their 'critical friend' (MH) in relation to the action research project, and to plan for upcoming lessons:

> *"...you need to have time to sit down with the other teachers who you're planning your vertical timetable with and say, at the end of the week, 'this is where we're at', 'this is what we covered', 'this is where we want to go next', 'where are you guys...where are the other teachers at?' because the goal still has to be there for all kids to be able to move between the levels and if you have one teacher that scoots along too fast then it can make the gap between the levels too great for kids to actually move to the next level. So that was invaluable, it gave us a lot more understanding of each other and how those kids were coping with different things."*

Tamika reflected on the resource sharing that occurred between teachers as a result of more open lines of communication about mathematics and lesson planning:

> *"If Mitch has an activity sheet he'll say 'this one is great', 'this one will work for your kids' and vice versa. We share activities. I find that we're communicating a lot because, like last year, the* [other teachers have] *kids that are in our class and we need to know where they're at and so we communicate where we're up to, what we're doing, etc. We discuss various children and where they are going."*

After the action research project which trialled vertical timetabling across Year 4 ended, the practice was institutionalised across the upper school (Years 4 to 7) at the commencement of the 2003 school year. When the Principal was asked to elaborate on her perceptions of teachers' attitudes to vertical timetabling in mathematics at the start of the new school year, she responded by saying:

> *"Administration, basically, has to give the information, they have to provide the way for it to happen and be prepared to advocate and to promote it. But I think it's got to be something that kids and teachers and parents actually get on and do. So it's like a parallel leadership model for teachers. They're out there doing it, they're good at it, and so I think that has to be respected and developed. [...] I think everybody in this project went into it because they could see that we had good kids here who needed a better opportunity to access and participate in their learning. Once again you've got to collaborate at the beginning; you've*

got to know what you're all on about. If it were something I tried to force into place undoubtedly it would have failed. It depended on the whole reason for doing it and how that fitted into the whole concept of the school. It fits in with Learning Place's concept of education—to do what we need to do in order to give teachers and kids the best opportunity for kids to engage in learning and be successful."

Conclusions

This study has demonstrated that strategies can be implemented that provide opportunities for students of all abilities to achieve to their maximum through joint planning, action research and a commitment to equitable educational practices. The extension of the programme beyond Year 4 is based on evidence collected formally through the action research process in which they worked with a critical friend (MH) to address some sacred cows. These teachers demonstrated considerable courage in addressing a difficult area and a practice shrouded in myth and misinformation.

The issue of ability grouping is controversial and a number of researchers have argued strongly against the practice on equity grounds. Streaming is argued to be a means of excluding weaker students from mathematics (Zevenbergen, 2001, 2003). Mixed ability classes and within mixed ability classrooms heterogeneous grouping practices are widely believed to be the desirable strategy. The teachers in this study have acknowledged these issues but by deliberately employing different teaching approaches and materials have tailored the curriculum to meet the needs of particular groups of students. Further research is needed to obtain rigorous evidence of long-term impacts on self-esteem, performance and learning will be necessary. However, the "success" of the innovation is testified by the intent of the school to expand the approach to include all grades from Years 4 to 7.

The concern expressed about the behavioural characteristics of students is interesting given that boring, meaningless curricula is often a contributor to behavioural problems. The opportunity to move potentially disruptive students on the basis of their ability rather than behavioural characteristics was seized. Indeed, a comment by Jill testifies to a "calmness" that descended on the classes.

Innovative teaching practices are always claimed to be constrained by lack of resources. However, joint planning and a differentiated programme do appear to ameliorate some of these concerns. Those students in greatest need of concrete manipulative materials are able to access these materials whereas those students who might require more access to abstract materials or data sources for more investigatory mathematics also can be accommodated.

Although the purpose of this study was primarily to implement and reflect on the establishment of a vertical timetable or ability grouping strategy, some evidence emerges that comments on the effectiveness of the innovation. Behavioural problems lessened, interest in mathematics increased, and the challenge of improving performance to aspire to join the advanced class was issues commented upon by the teachers. Parental acceptance and support also appears to be substantial.

As an exercise in school change and management this project has successfully demonstrated collegiality typical of a learning community focussed on enhanced practice and aspiring to achieve excellence. Structures are in place to support those students struggling in mathematics as well as those with considerable potential. This study provides a case report of how one school has approached the provision of equitable education practices; through action research and curriculum decision-making that was grounded in evidence-based practice. As such this represents a model for similar schools to emulate.

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